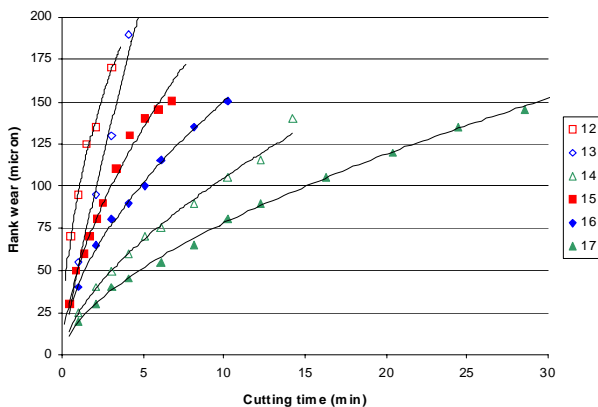


Tool Life Optimization in Hard Turning

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Machining hardened steel parts has become a very important manufacturing process, particularly in the automotive and bearing industries. Abrasive processes such as grinding have typically been required due to the hardness of the material, but advances in machine tool technology and cutting tool materials has allowed turning of hardened steels to become a realistic replacement for many grinding applications. There are many advantages of hard turning, such as increased flexibility, decreased cycle times, reductions in capital expenditures, and reductions in environmentally hazardous cutting fluids. Despite these advantages, implementation of hard turning is relatively low, primarily due to concerns about the surface integrity of hard turned parts and a lack of understanding of the wear behavior of CBN cutting tools. Aggressive tool wear or premature tool failure can eliminate any cost savings associated with hard turning, therefore industry is reluctant to replace well understood grinding operations.

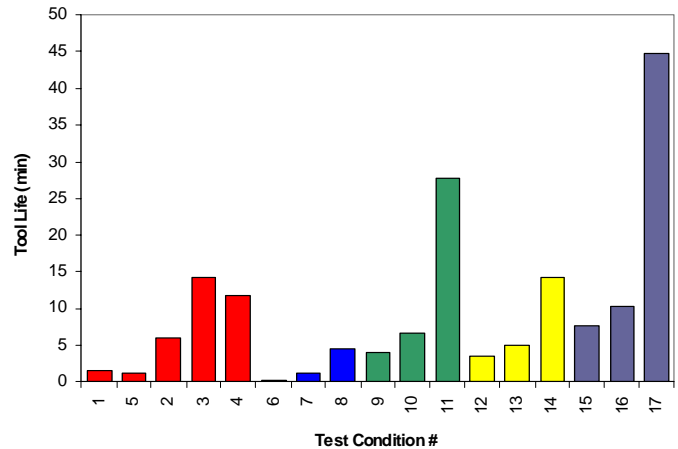


Plot of flank wear vs. cutting time in hard turning for various tools and cutting conditions. A theory based exponential relationship between flank wear and tool operating conditions is under development.

Due to the potential advantages of the hard turning process, this research proposes to investigate the wear behavior of CBN cutting tools in hard turning applications with the hope that findings will lead to further implementation in industry. Preliminary testing has shown a repeatable trend in the wear behavior of several different tool materials at a range of cutting conditions.

Further experimental work in combination with the development of a wear model based on the fundamental wear mechanisms typical in metal cutting will help to identify the effect of cutting parameters and tool material on wear behavior and tool life. Additionally, this research

will utilize response surface analysis with a central composite experimental design to optimize the hard turning process and determine ideal process conditions.



Plot showing the effect of tool lifetime in minutes related to test conditions that include tool manufacturer, cutting speed, cutting feed, and depth of cut.



Ty Dawson is a Ph.D. Candidate working on research in the area of tool life optimization in hard turning. He received his BSME degree from Valparaiso University in 1996 and started graduate studies at Georgia Tech in the fall of 1997. He received his MSME from Georgia Tech in 1999, and plans to graduate with a Ph.D. in mechanical engineering by May, 2002. He is currently looking for

opportunities related to his research interests: materials and manufacturing, with particular interest in machining difficult materials and development of advanced cutting tool materials and coatings.

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